Kinetic vs. Potential ENERGY

Physical Science

Mechanical Energy

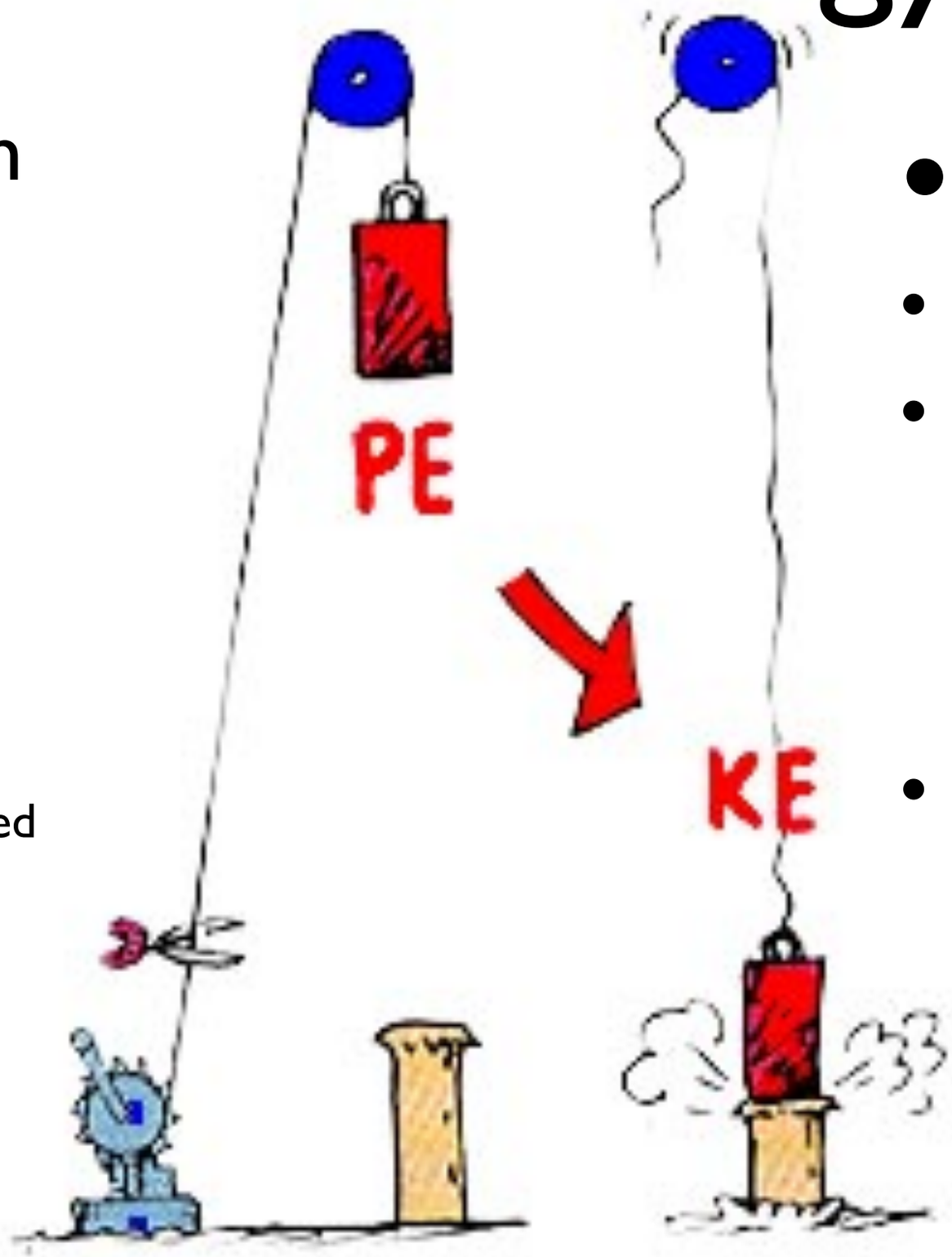
Mechanical Energy = Kinetic + Potential Energy

OR

ME = KE + PE

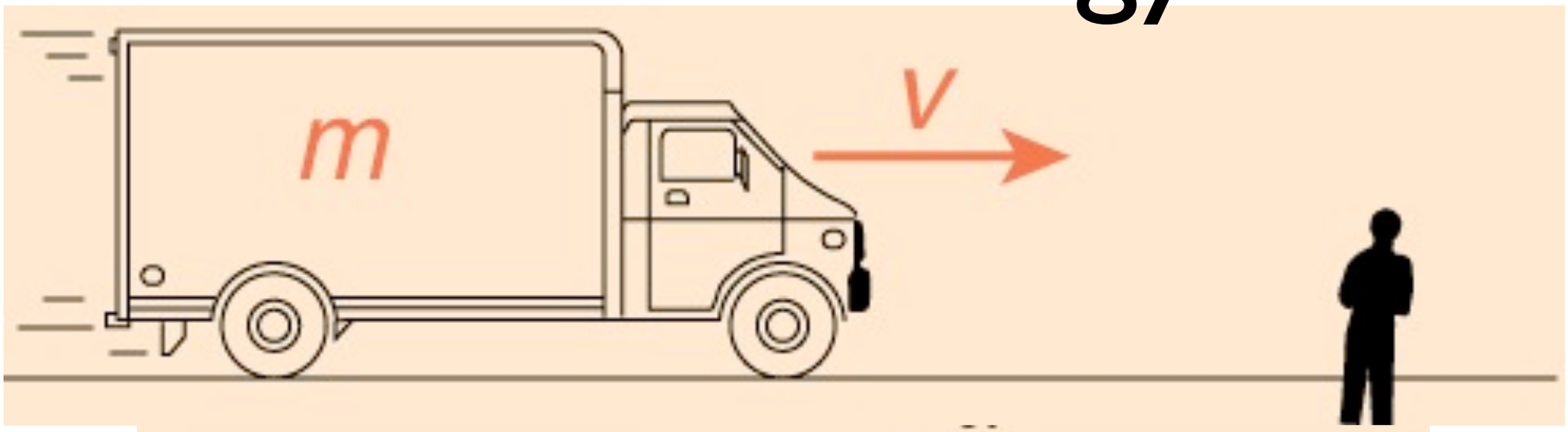
Kinetic Energy

- GPE = mgh
  - m = mass
  - g = acceleration due to gravity
  - h = height of the object
- Stored energy based on height



- KE = $^1/_2 * m * v^2$
  - m = mass
  - v = velocity of the object
- Moving energy based on objects velocity

Kinetic Energy



You know intuitively that the KE depends upon the speed of the truck. A faster truck can do more work on you.

The KE depends upon the square of the velocity! So at twice the speed, the truck has 4 x the energy! Why does it increase by the square?

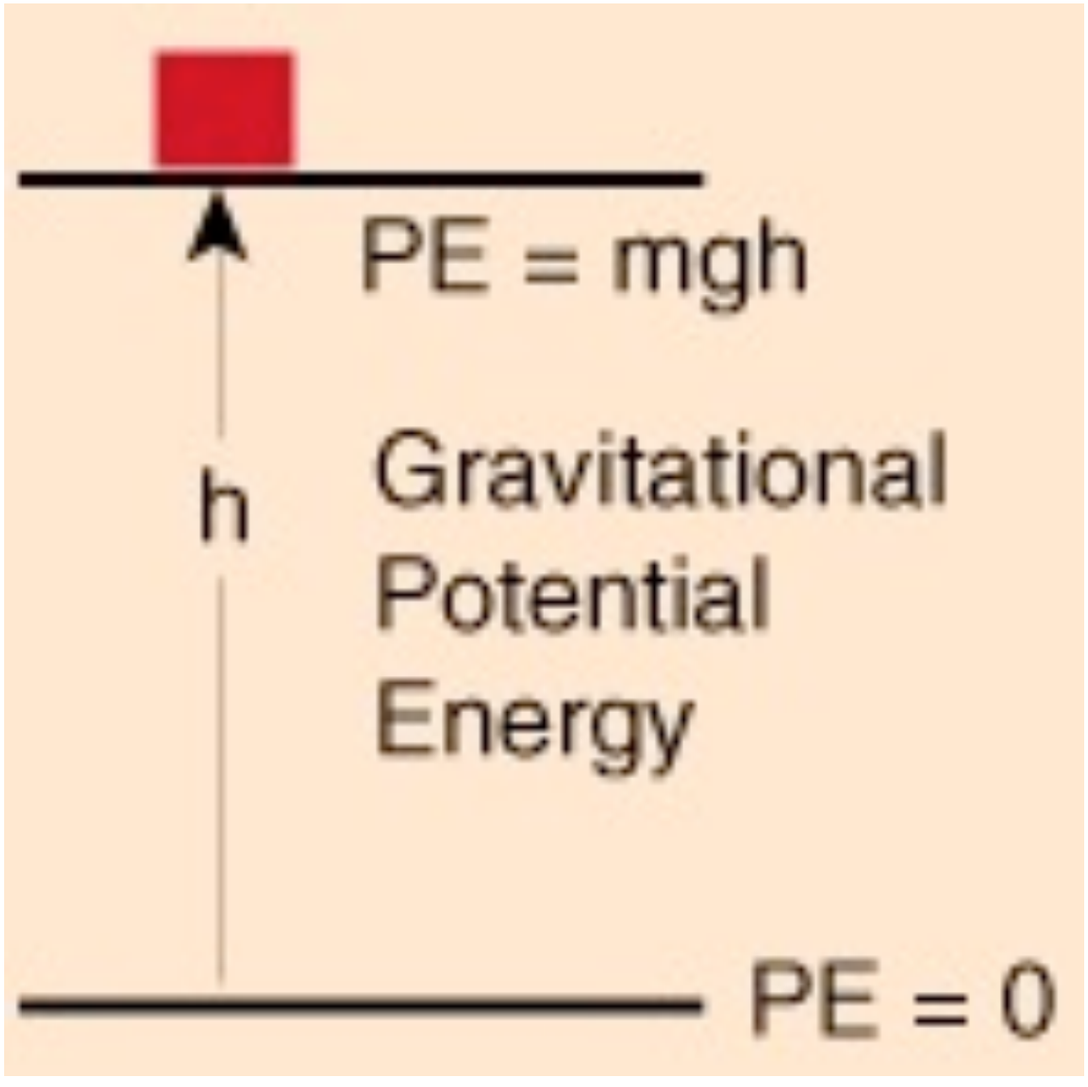
$$KE = \frac{1}{2}mv^2$$

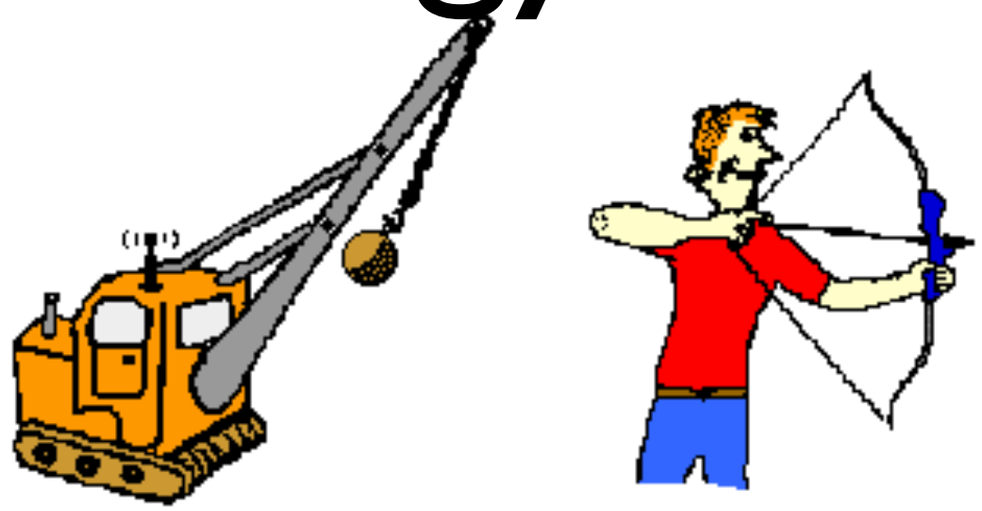
Where does the factor 1/2 come from?

You know intuitively that the KE depends upon the mass of the truck. A more massive truck could do more work on you.

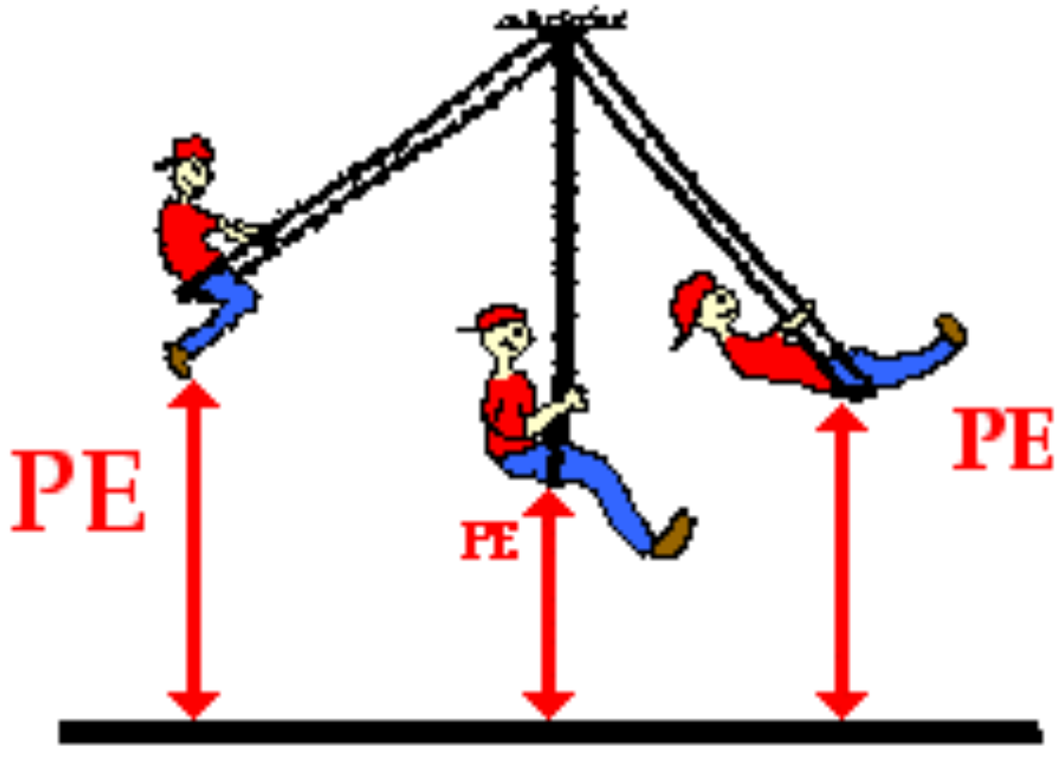
Potential energy

- PE = mgh

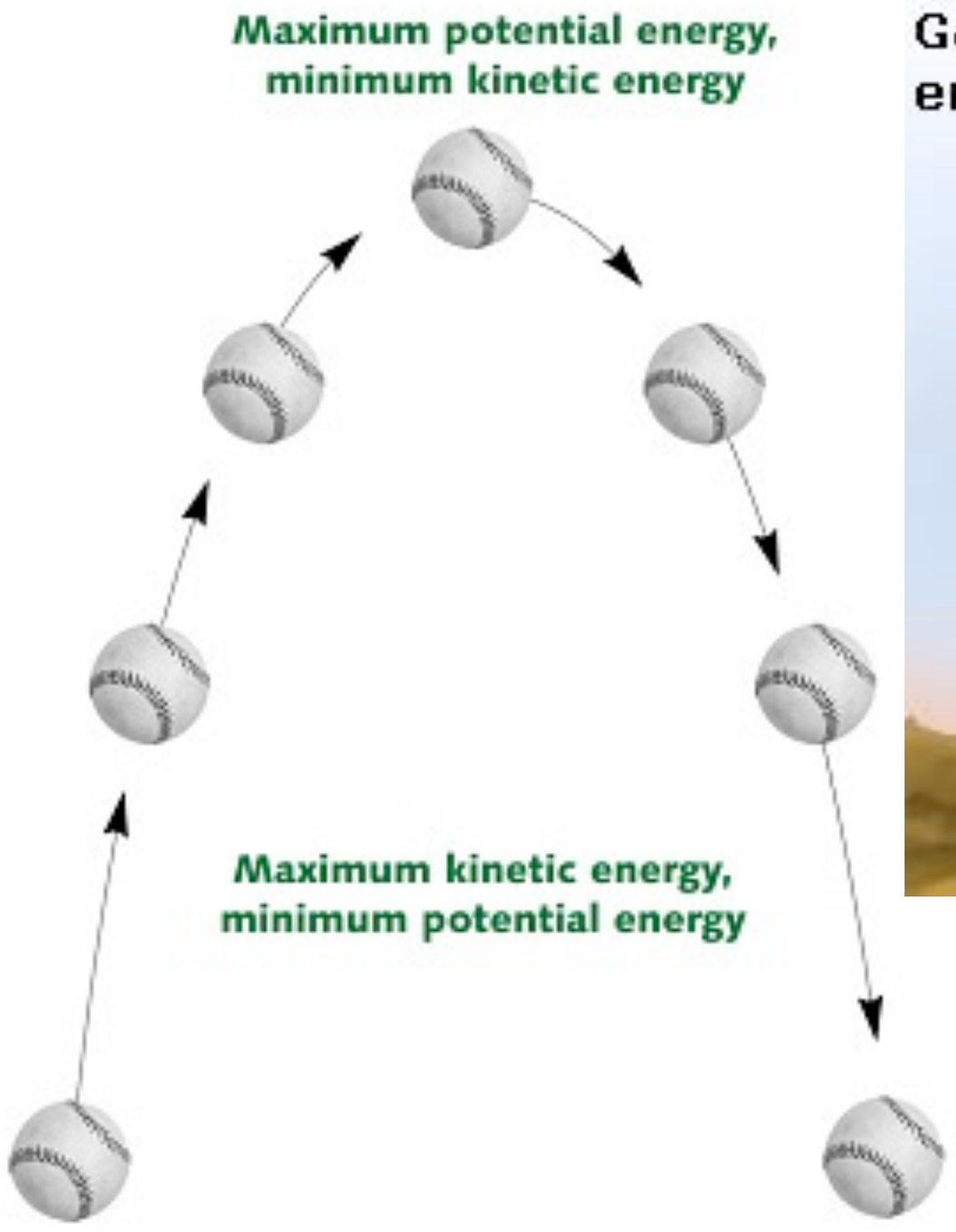


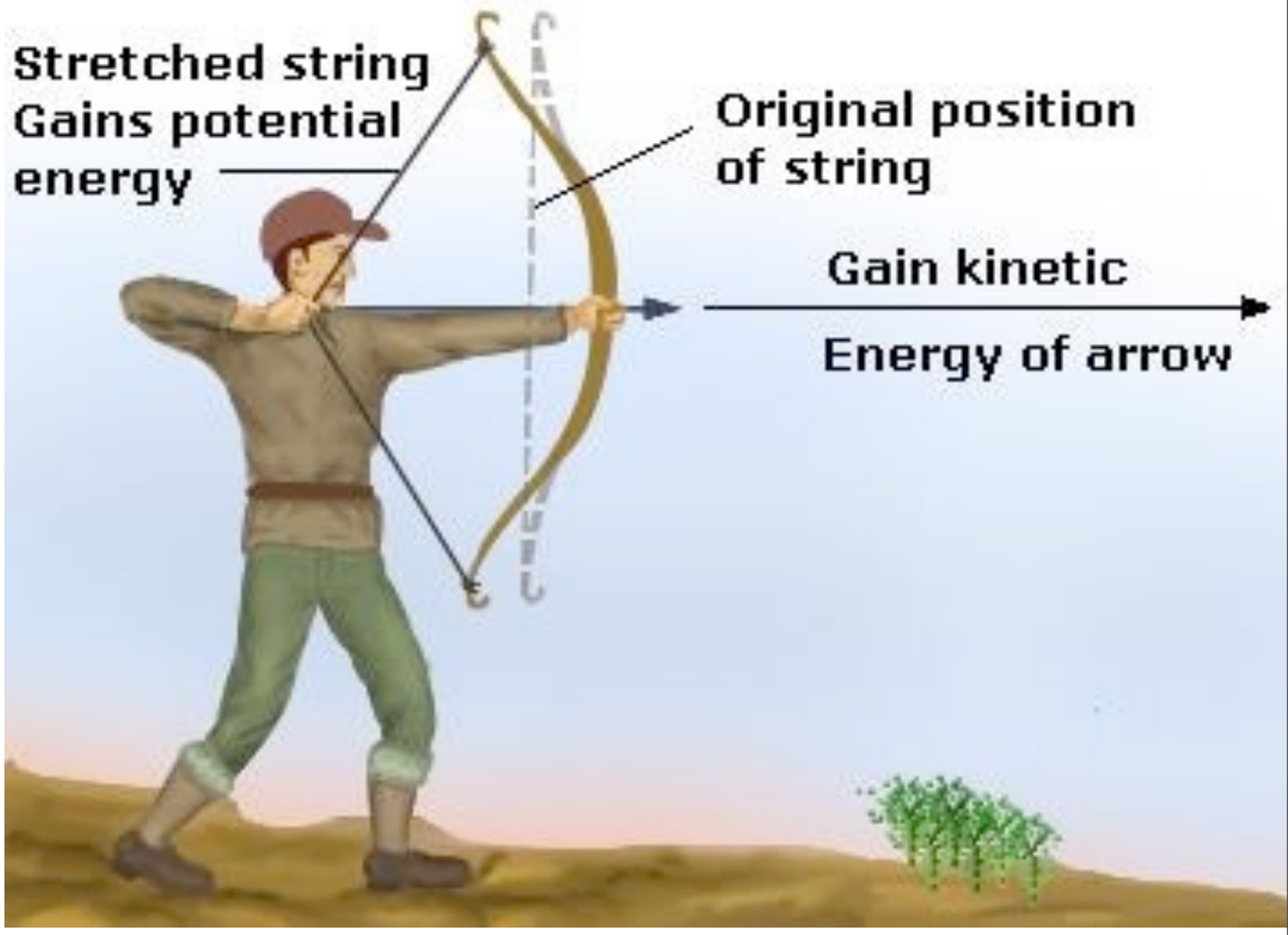


The massive ball of a demolition machine and the stretched bow possesses stored energy of position - potential energy.

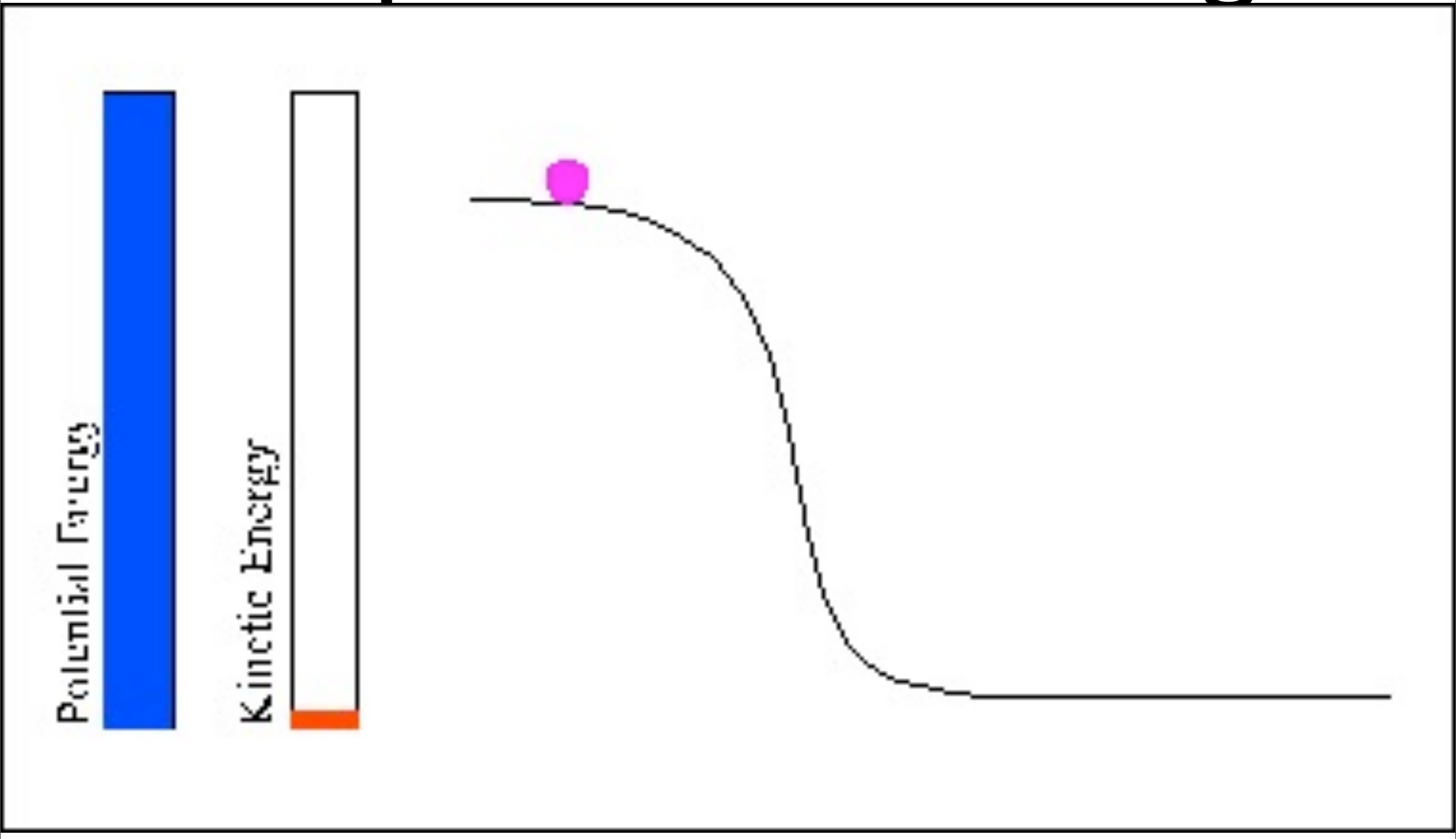


How Do They relate?

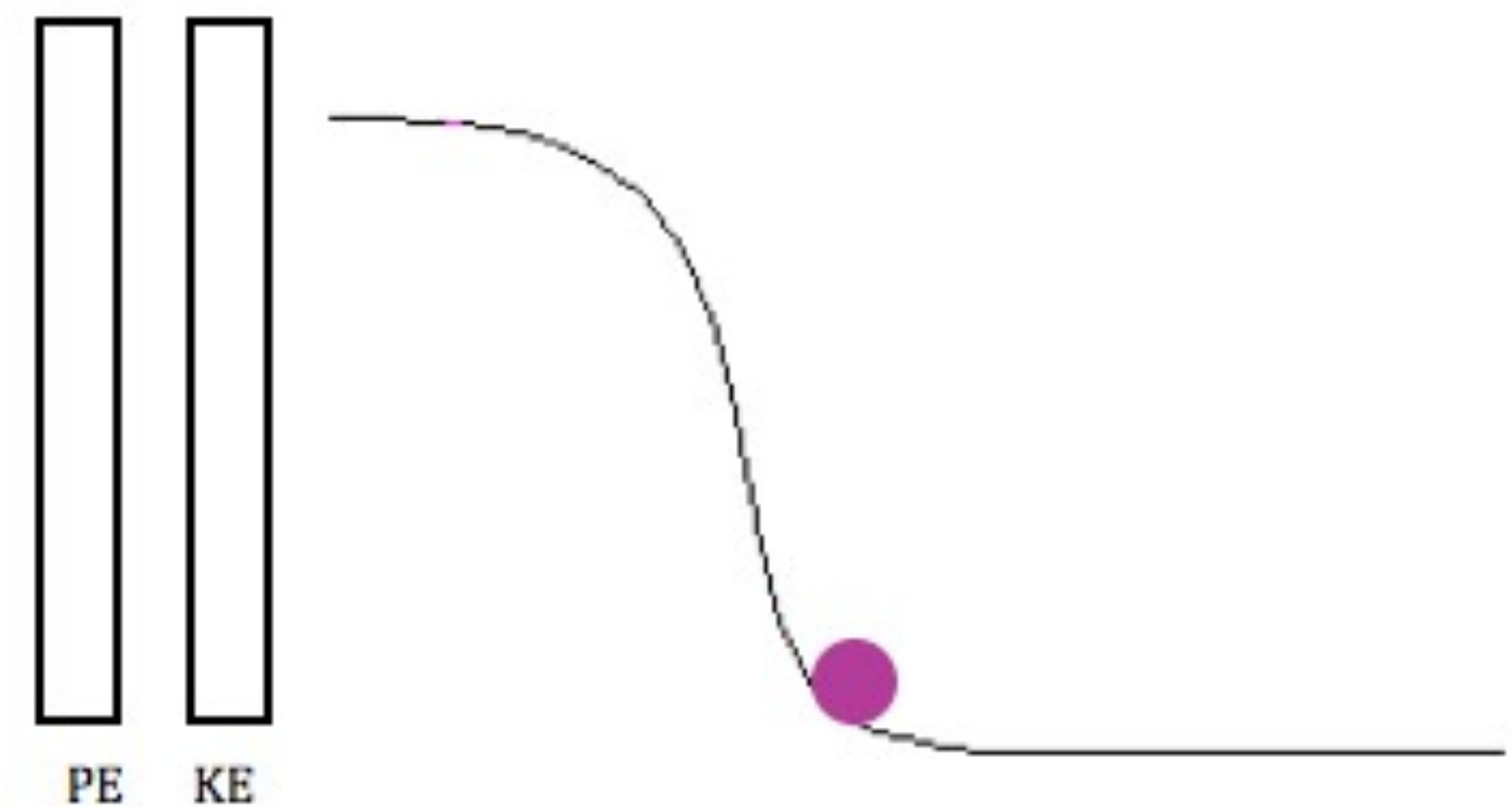


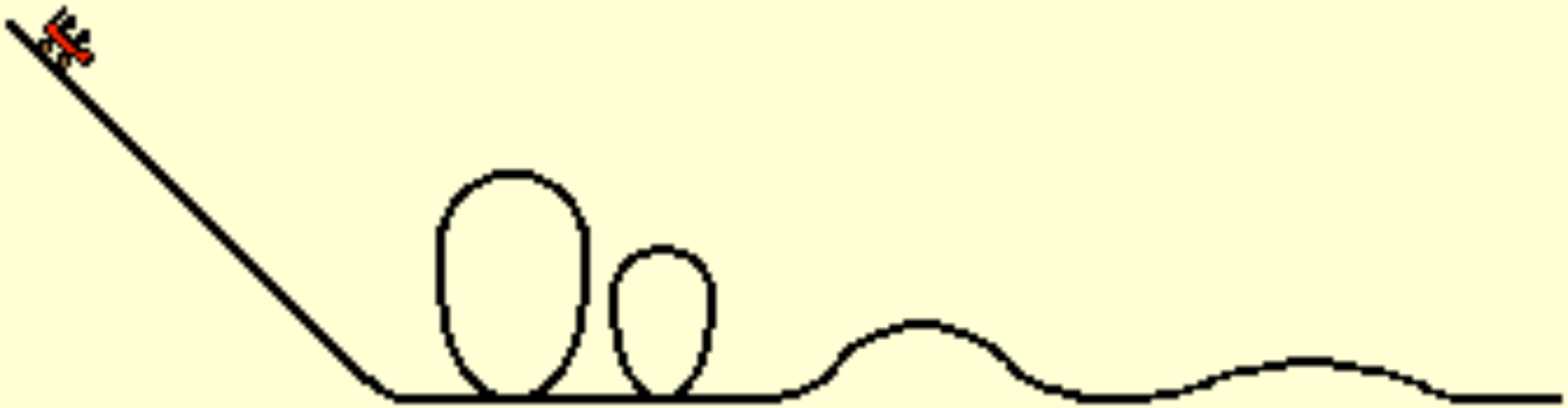


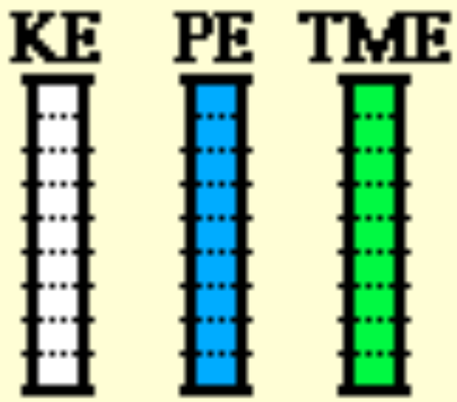
Simple Understanding



Shade in the KE & PE

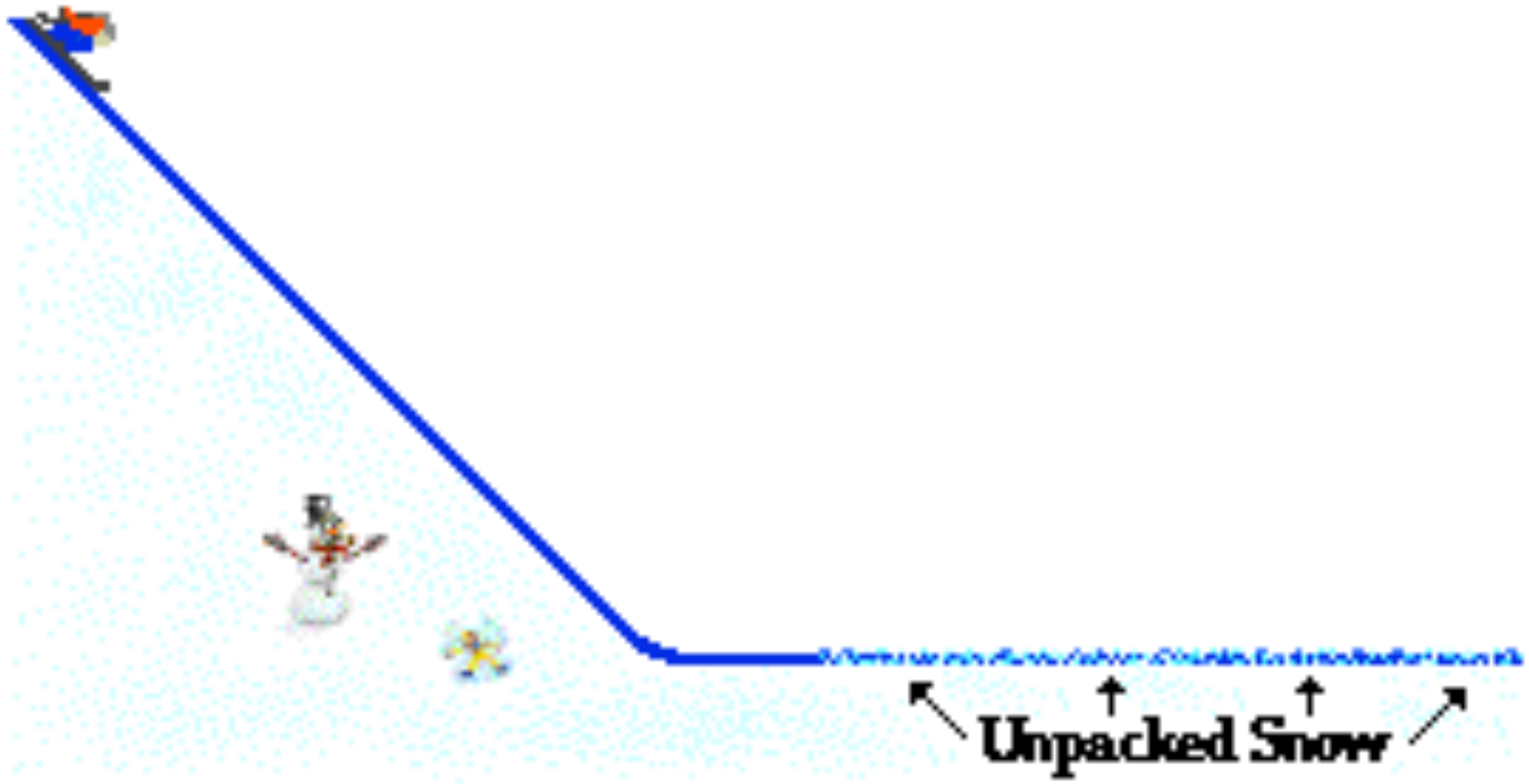


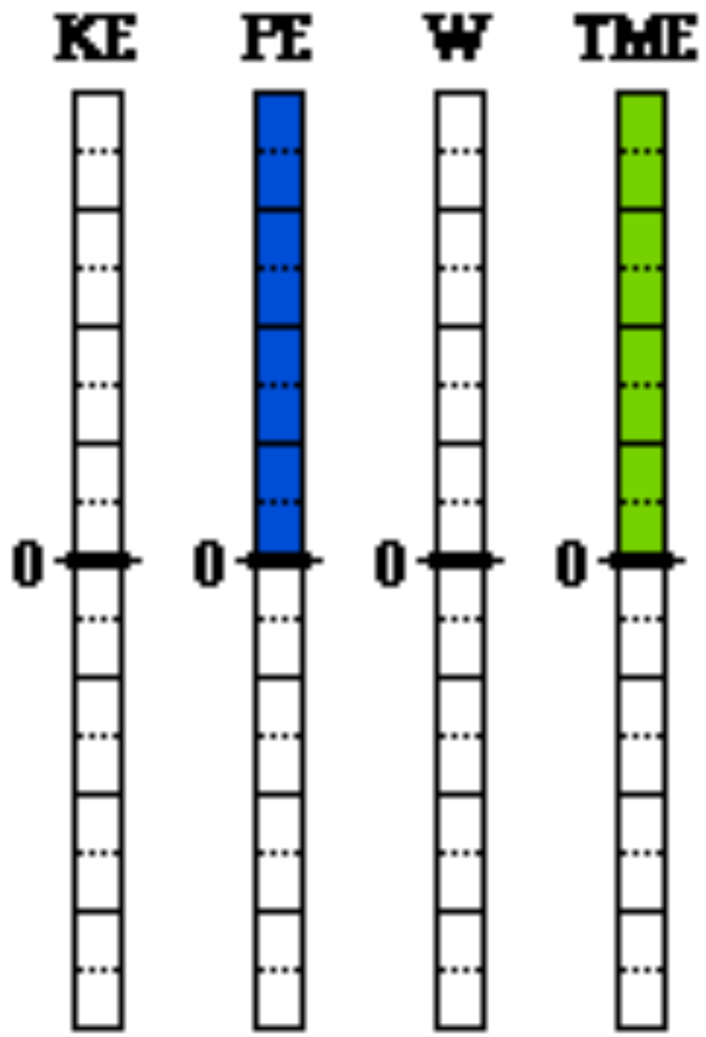




Height = 72.0 m

Speed = 0.0 m/s





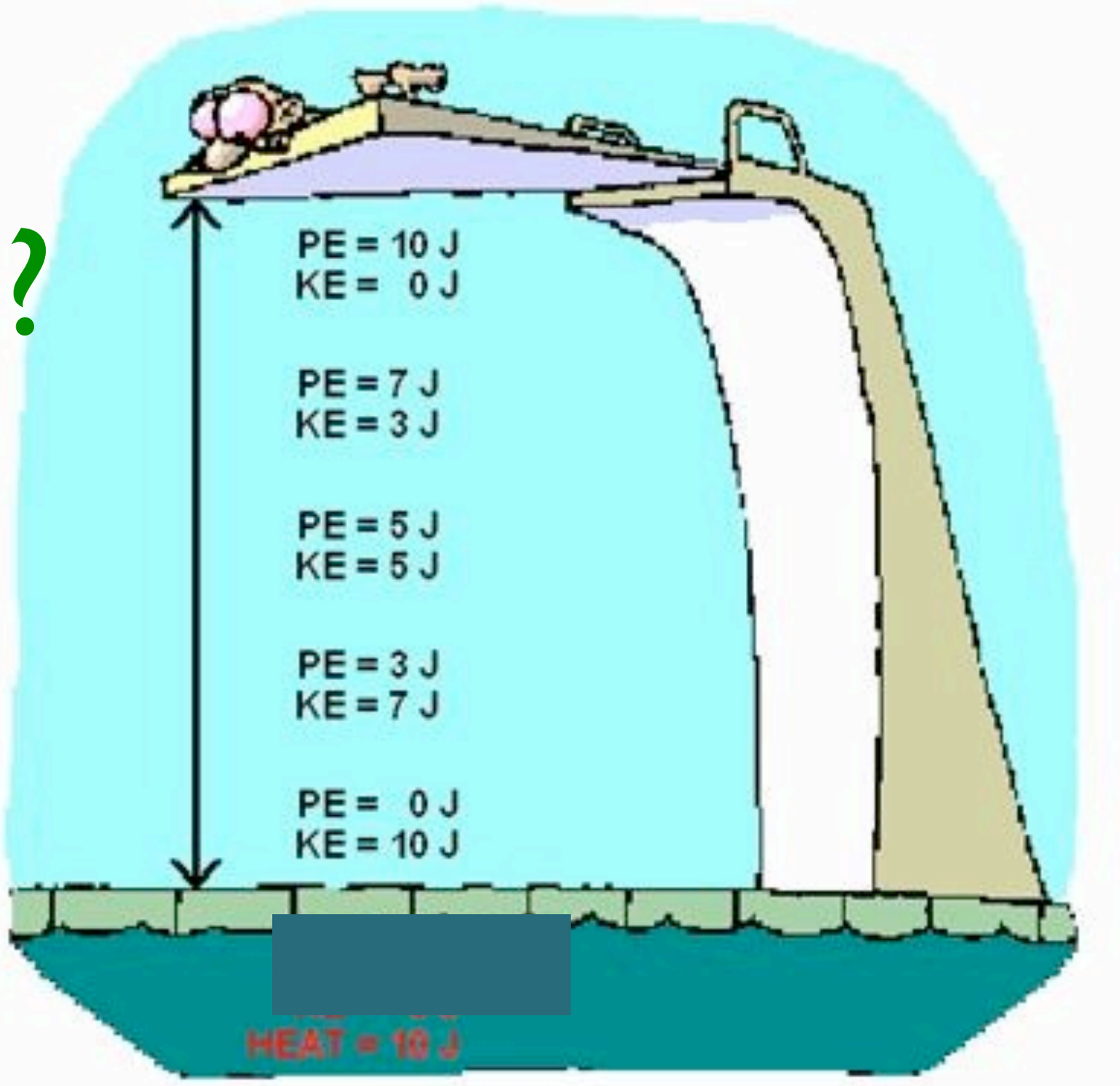
Unpacked Snow

Height = 52.0 m

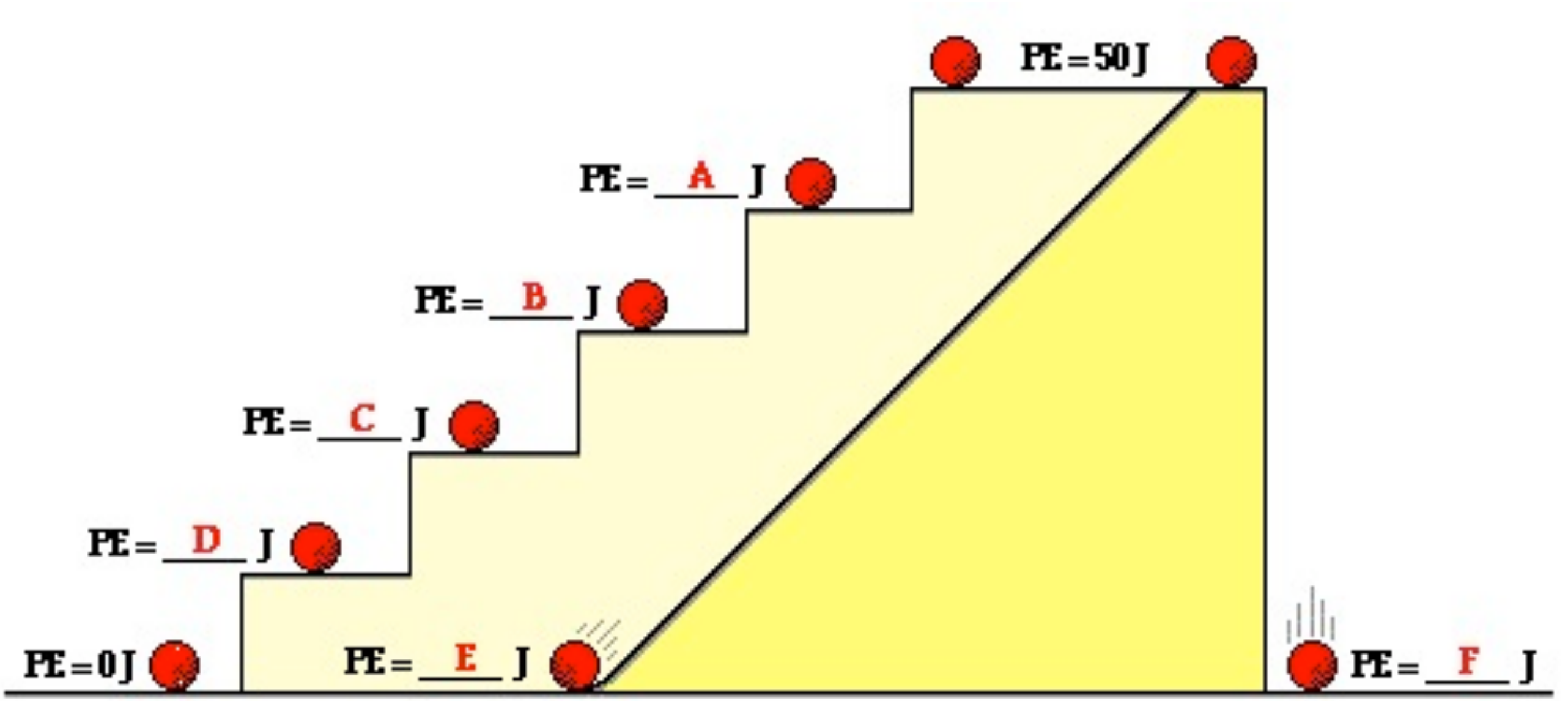
Speed = 0.0 m/s

Also Mathematically!

ME = ?



Understanding Check



Quick Quiz Answer

A: PE = 40 J (since the same mass is elevated to 4/5-ths height of the top stair)

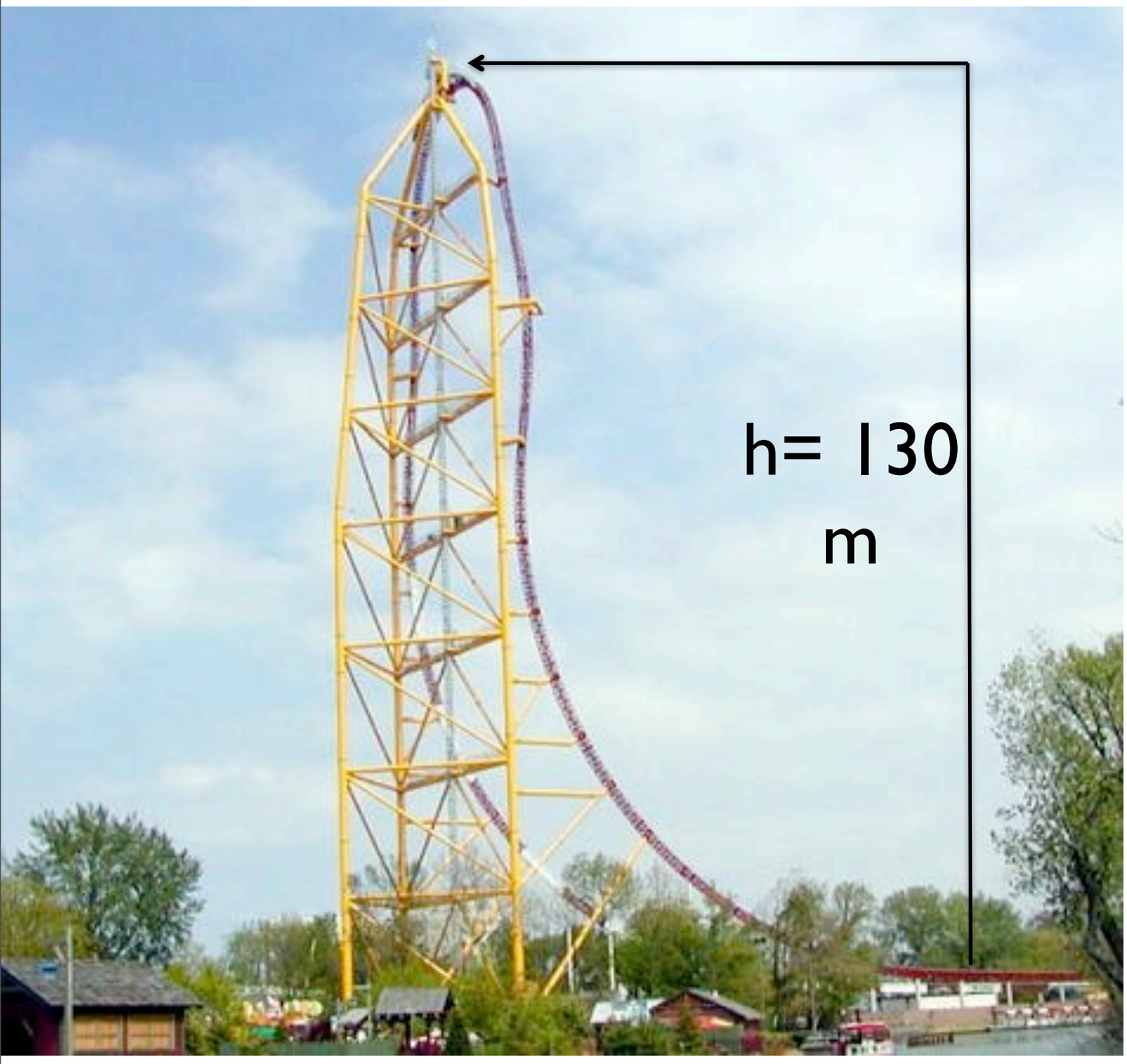
B: PE = 30 J (since the same mass is elevated to 3/5-ths height of the top stair)

C: PE = 20 J (since the same mass is elevated to 2/5-ths height of the top stair)

D: PE = 10 J (since the same mass is elevated to 1/5-ths height of the top stair)

E and F: PE = 0 J (since the same mass is at the same zero height position as shown for the bottom stair).

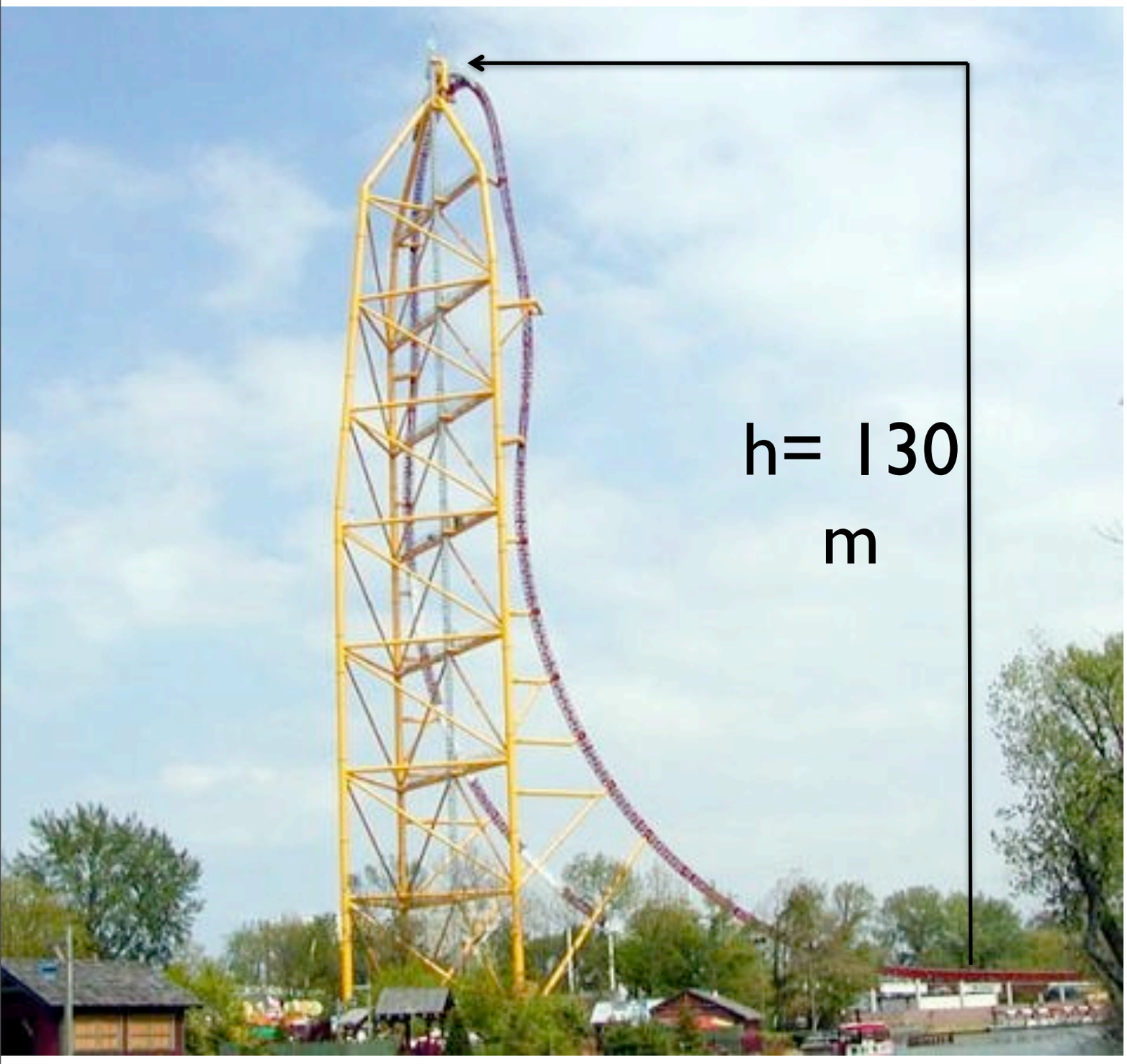
Real Life Examples:
The Top Thrill Dragster!



If the mass of your roller car and people are 1000kg and you are clocked at 50.5 m/s are the bottom of the hill…

What is your PE at the top of the ride?

Real Life Examples:
The Top Thrill Dragster!



If the mass of your roller car and people are 1000kg and you are clocked at 50.5 m/s are the bottom of the hill…

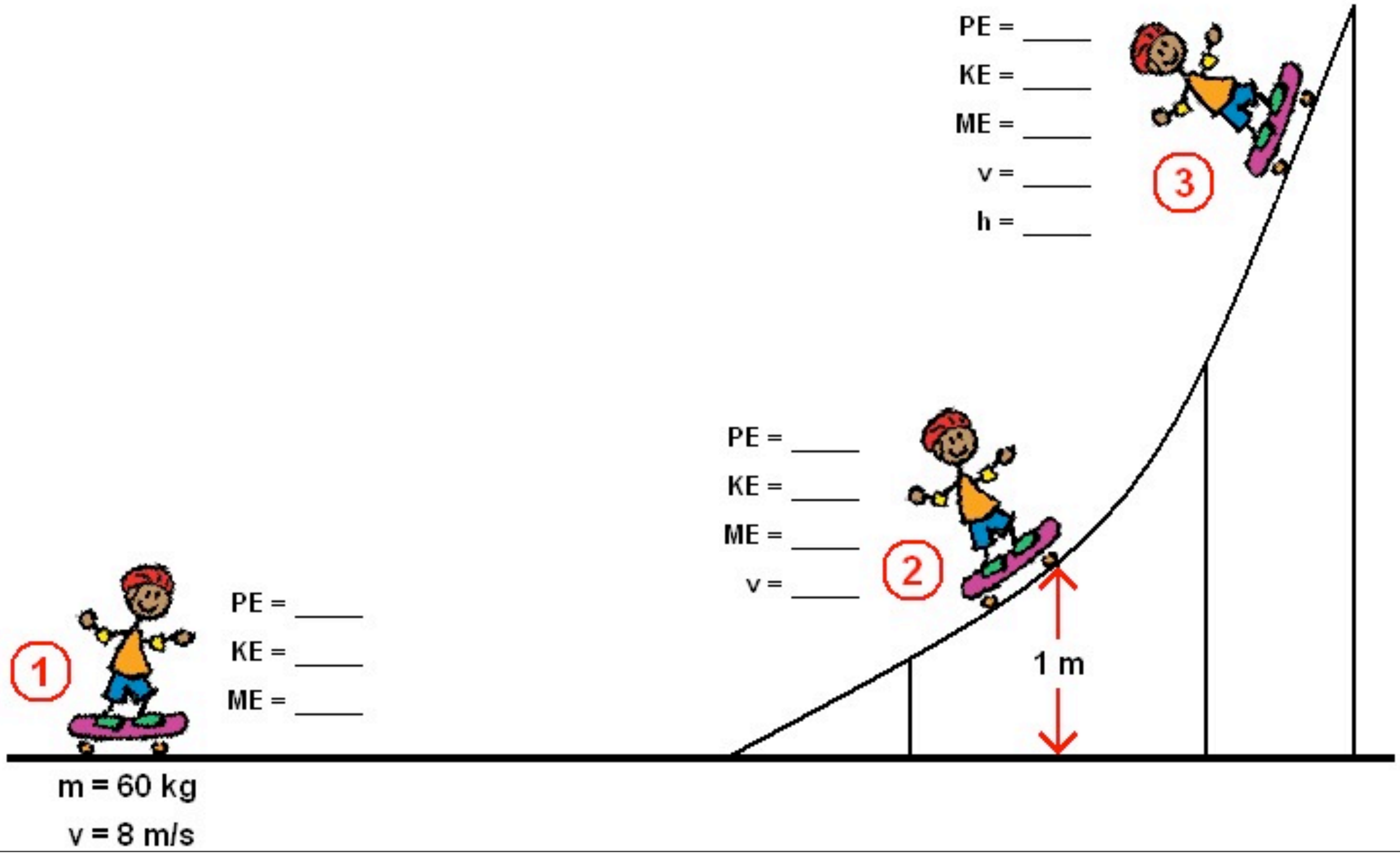
What is your PE at the top of the ride?

PE = mgh

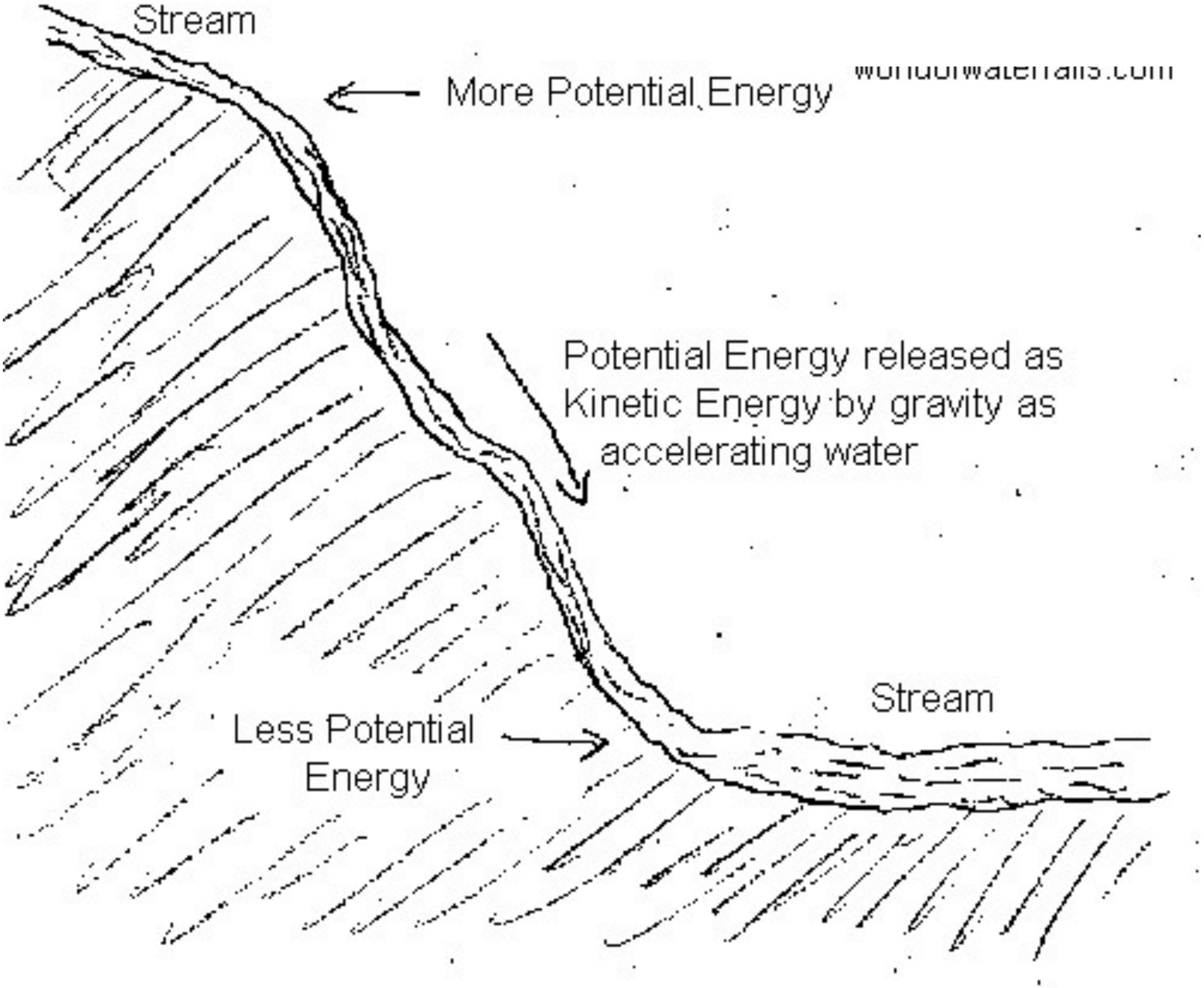
PE = (1000)(9.81)(130)

PE = 1,275,300 J

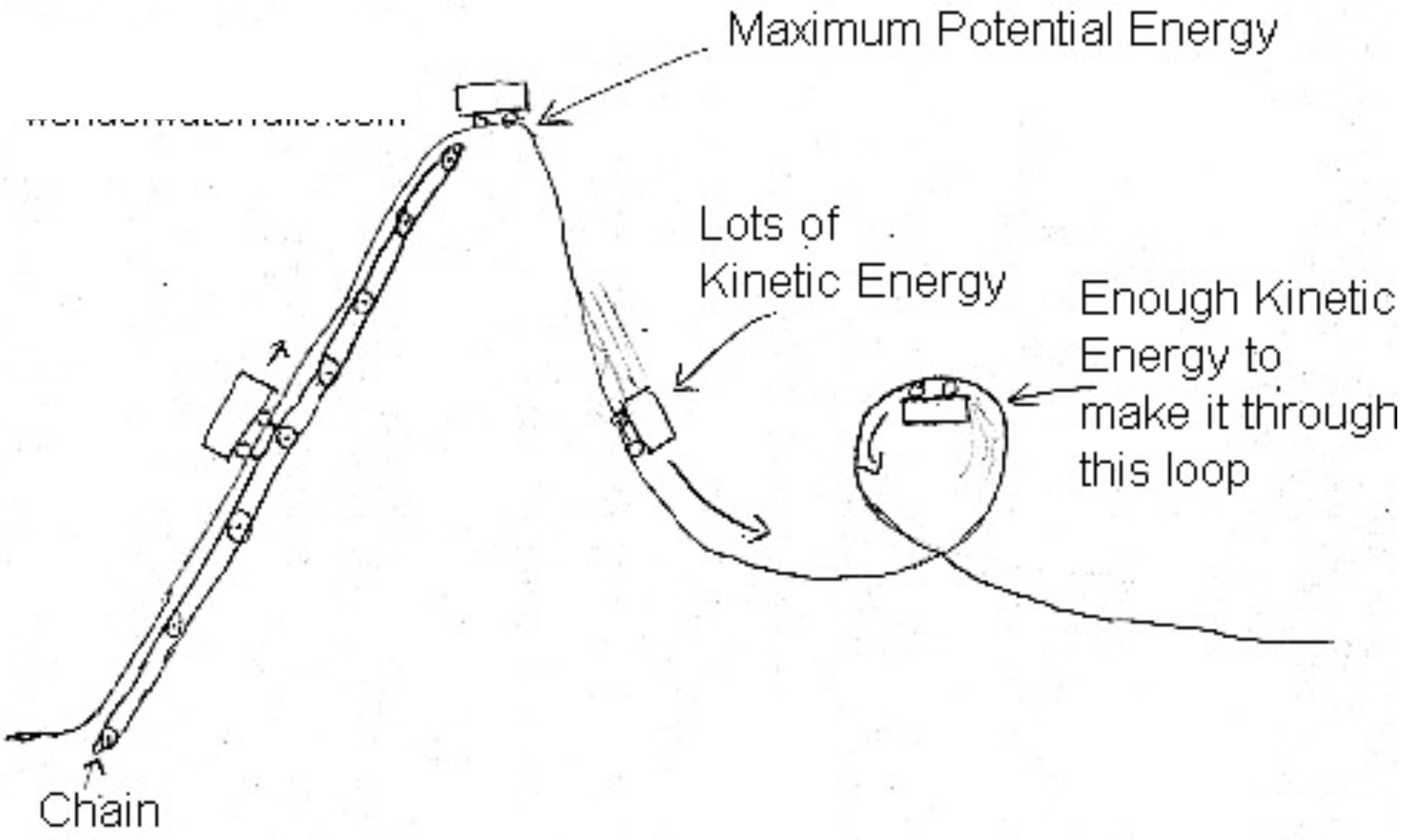
EXAMPLE



OGT EXAMPLE


Stream
More Potential Energy
Potential Energy released as
Kinetic Energy by gravity as
accelerating water
Less Potential
Energy
Stream

OGT EXAMPLE


Maximum Potential Energy
Lots of
Kinetic Energy
Enough Kinetic
Energy to
make it through
this loop
Chain

Energy

Can a roller coaster ever have a second hill as high as the first?

Energy

IV.Heat transfer occurs when energy is lost to surrounding environment

Energy

A. Fact about heat

1. Heat moves from a warm to cold.

a. Hot objects will cool.

b. Cold objects will heat up.

Energy

Energy

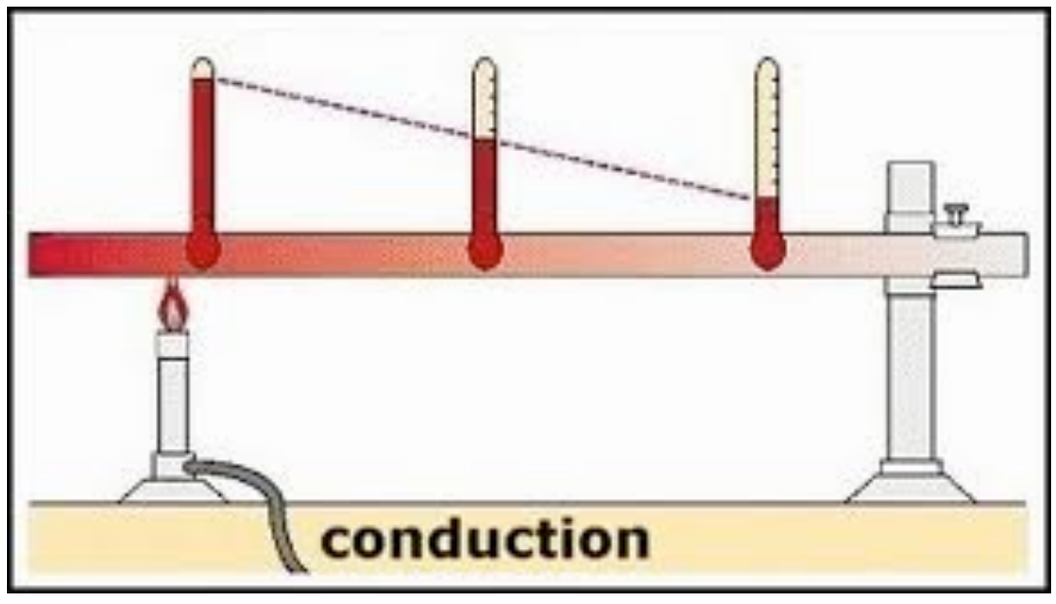
- If a cup of coffee and a ice water were left on the table in this room what would happen to them? Why?

Energy

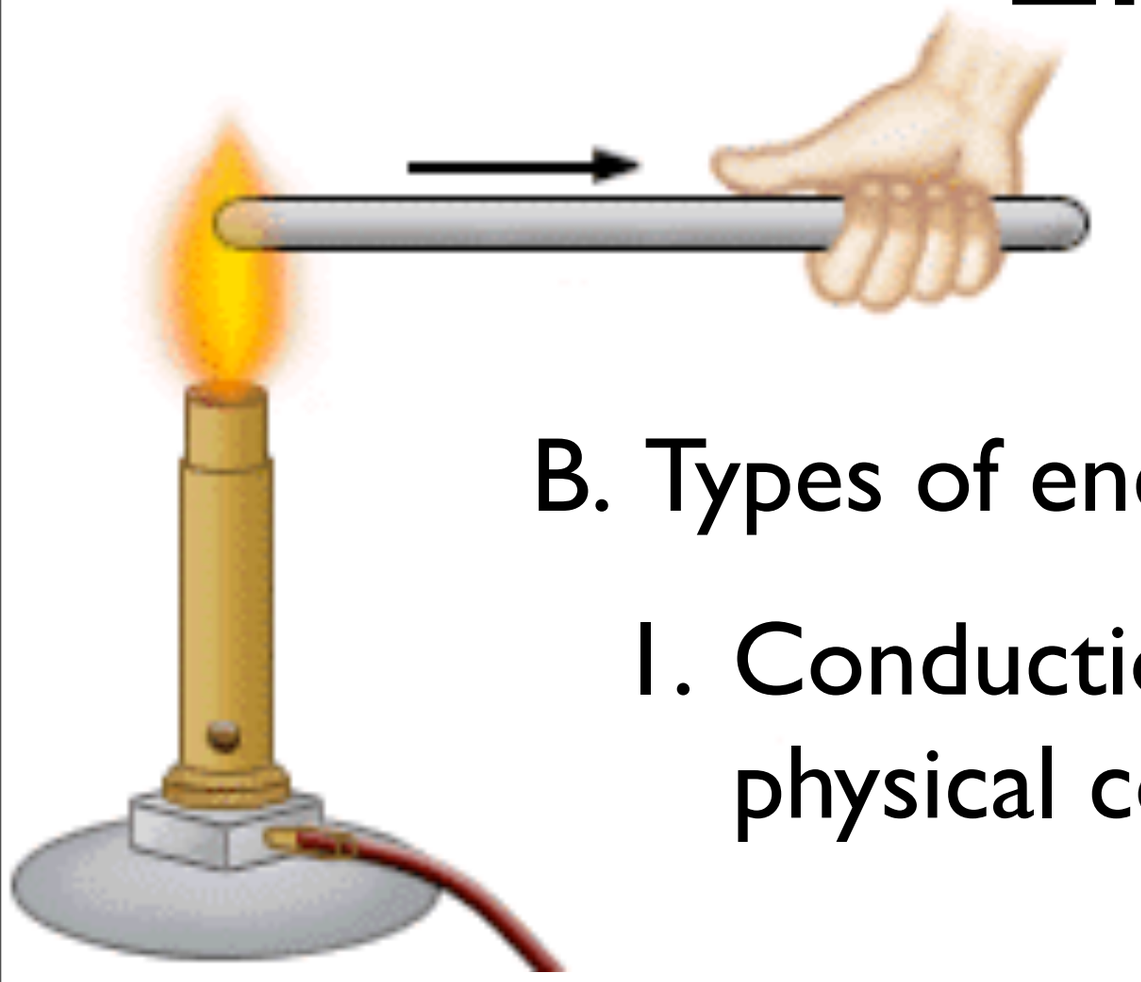
- If a cup of coffee and a ice water were left on the table in this room what would happen to them? Why?
- The cup of coffee will cool until it reaches room temperature. The ice will melt and then the water will warm to room temperature.

CONDUCTION

- Thermal conduction – the transfer of energy as heat through a material
  - Occurs when objects that are in direct contact are at unequal temperatures



Energy



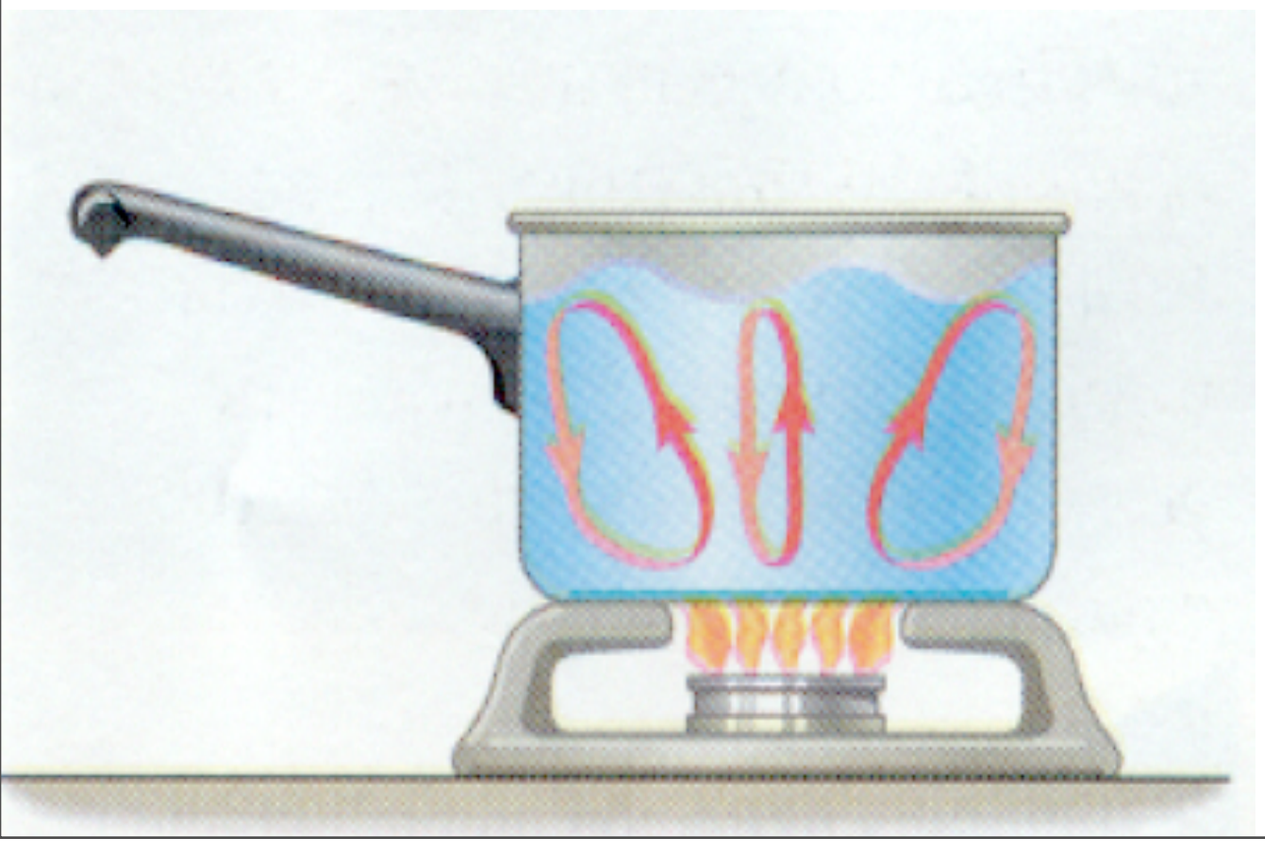
B. Types of energy transfer

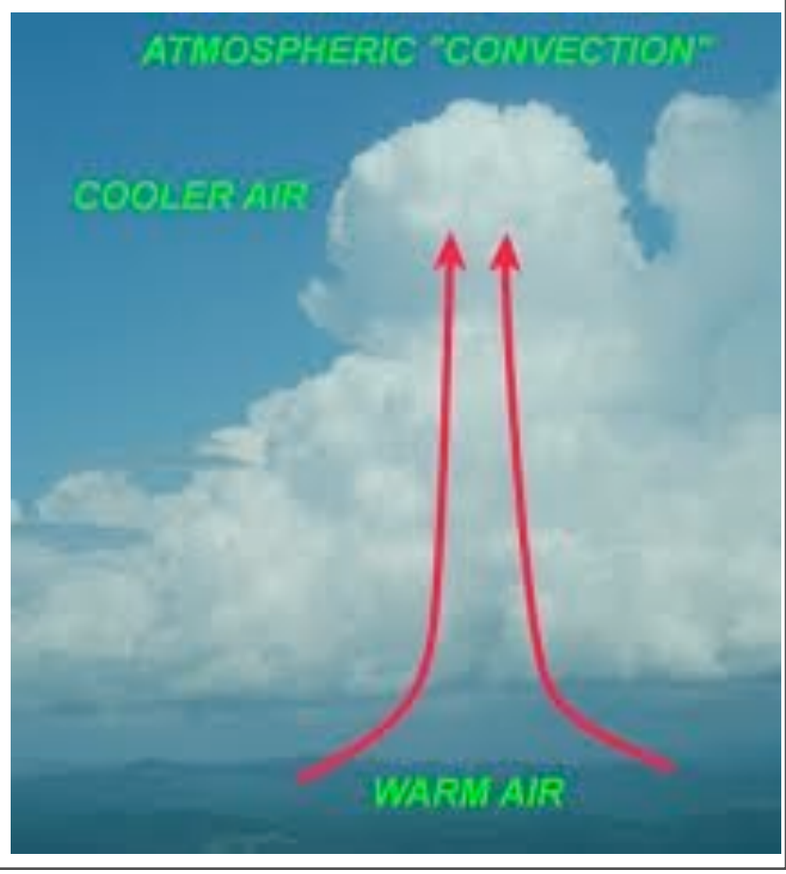
1. Conduction - heating of material by physical contact

Energy

2. Convection - movement of matter due to differences in density caused by temperature variation.

a. Only possible in liquid and gas



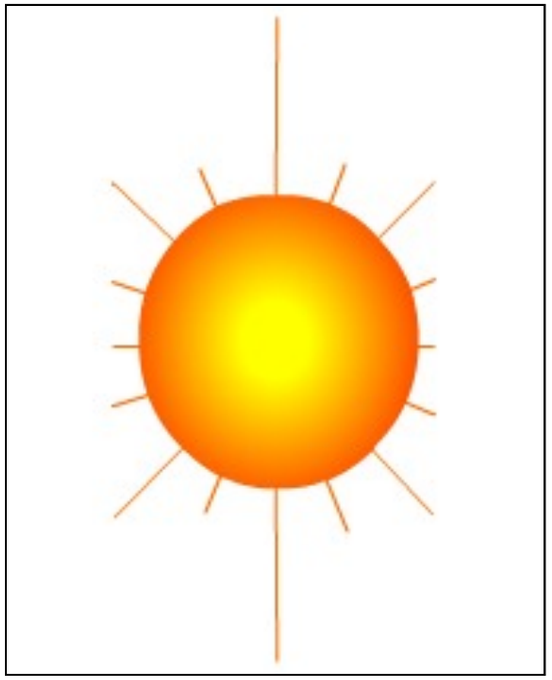


Energy

3. Radiation - energy that is transferred as electromagnetic waves such as visible light and infrared waves

    a. Does not require physical contact and no matter is moved

How does heat energy get from the Sun to the Earth?



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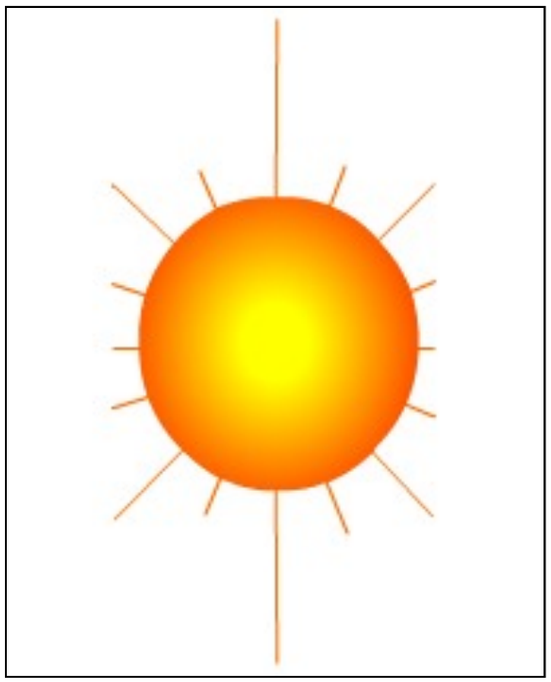

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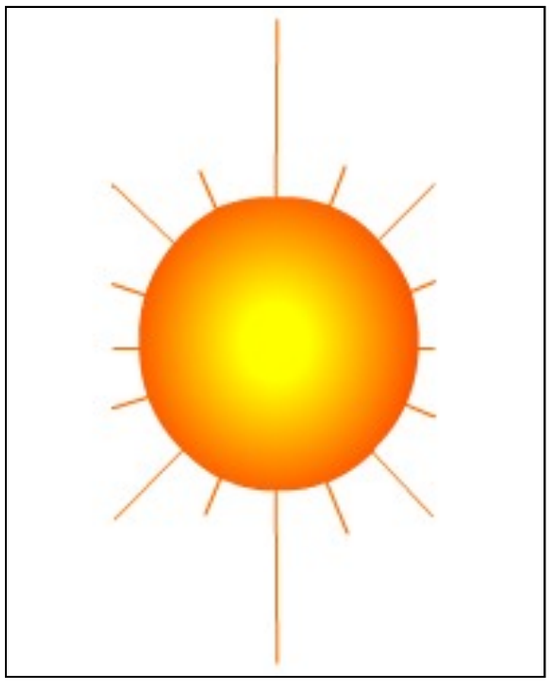
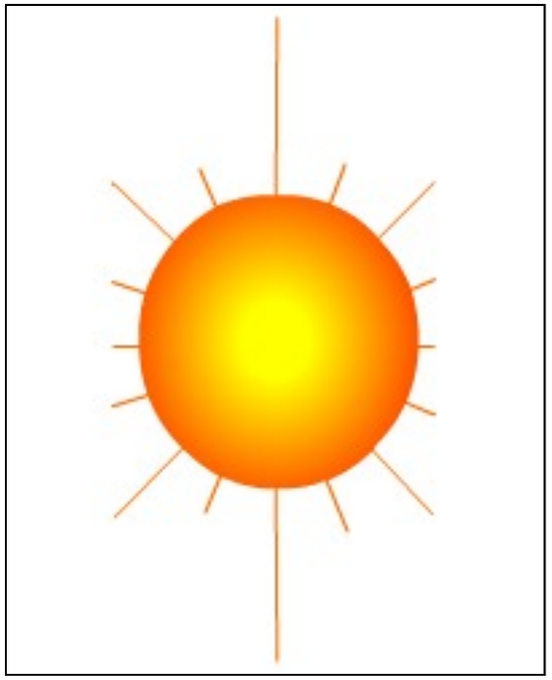


?

There are no particles between the Sun and the Earth so it CANNOT travel by conduction or by convection.

How does heat energy get from the Sun to the Earth?



?

RADIATION

There are no particles between the Sun and the Earth so it CANNOT travel by conduction or by convection.

Radiation

Radiation

Radiation travels in straight lines
True/False
Radiation can travel through a vacuum
True/False
Radiation requires particles to travel
True/False
Radiation travels at the speed of light
True/False

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Radiation

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True/~~False~~

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True/False

Radiation travels at the speed of light

True/False

Radiation

Radiation travels in straight lines

True/~~False~~

Radiation can travel through a vacuum

True/~~False~~

Radiation requires particles to travel

~~True~~/False

Radiation travels at the speed of light

True/False

Radiation

Radiation travels in straight lines

True/~~False~~

Radiation can travel through a vacuum

True/~~False~~

Radiation requires particles to travel

~~True~~/False

Radiation travels at the speed of light

True/~~False~~

Convection questions

Why does hot air rise and cold air sink?

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Cool air is more dense than warm air, so the cool air 'falls through' the warm air.

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Why are boilers placed beneath hot water tanks in people's homes?

Convection questions

Why does hot air rise and cold air sink?

Cool air is more dense than warm air, so the cool air 'falls through' the warm air.

Why are boilers placed beneath hot water tanks in people's homes?

Hot water rises.
So when the boiler heats the water, and the hot water rises, the water tank is filled with hot water.

Radiation questions

Why are houses painted white in hot countries?

Why are shiny foil blankets wrapped around marathon runners at the end of a race?

Radiation questions

Why are houses painted white in hot countries?

White reflects heat radiation and keeps the house cooler.

Why are shiny foil blankets wrapped around marathon runners at the end of a race?

Radiation questions

Why are houses painted white in hot countries?

White reflects heat radiation and keeps the house cooler.

Why are shiny foil blankets wrapped around marathon runners at the end of a race?

The shiny metal reflects the heat radiation from the runner back in, this stops the runner getting cold.

1. Which of the following is not a method of heat transfer?

A. Radiation

B. Insulation

C. Conduction

D. Convection

1. Which of the following is not a method of heat transfer?

A. Radiation

B. Insulation

C. Conduction

D. Convection

2. In which of the following are the particles closest together?

A. Solid

B. Liquid

C. Gas

D. Fluid

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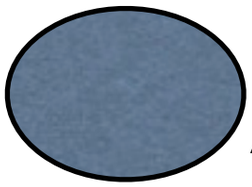


A. Solid

B. Liquid

C. Gas

D. Fluid

3. How does heat energy reach the Earth from the Sun?

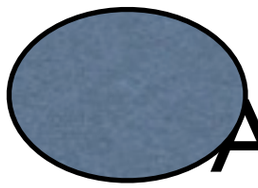
A. Radiation

B. Conduction

C. Convection

D. Insulation

3. How does heat energy reach the Earth from the Sun?



A. Radiation

B. Conduction

C. Convection

D. Insulation

4. Which is the best surface for reflecting heat radiation?

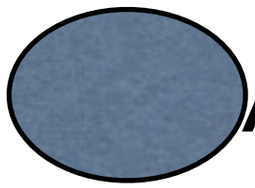
A. Shiny white

B. Dull white

C. Shiny black

D. Dull black

4. Which is the best surface for reflecting heat radiation?



A. Shiny white

B. Dull white

C. Shiny black

D. Dull black

5. Which is the best surface for absorbing heat radiation?

A. Shiny white

B. Dull white

C. Shiny black

D. Dull black

5. Which is the best surface for absorbing heat radiation?

A. Shiny white

B. Dull white

C. Shiny black

D. Dull black

What is true about the potential energy of a skydiver falling at terminal velocity?

A. Increase

B. Decrease

C. Remain constant

What is true about the kinetic energy of a skydiver falling at terminal velocity?

A. Increase

B. Decrease

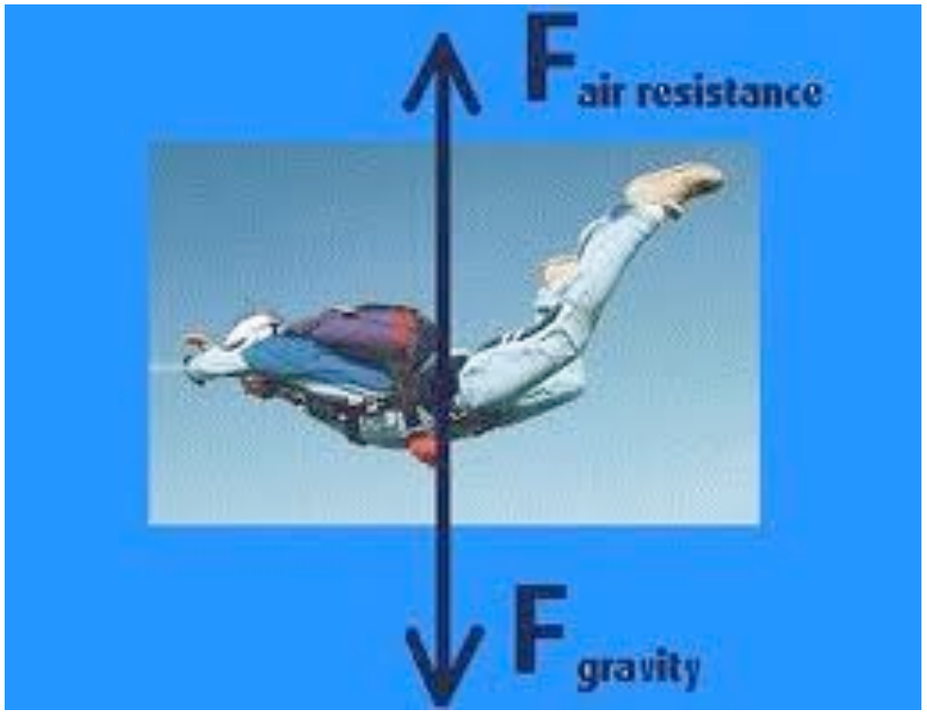
C. Remain constant

What is true about the kinetic energy of a skydiver falling at terminal velocity?

A. Increase

B. Decrease

C. Remain constant



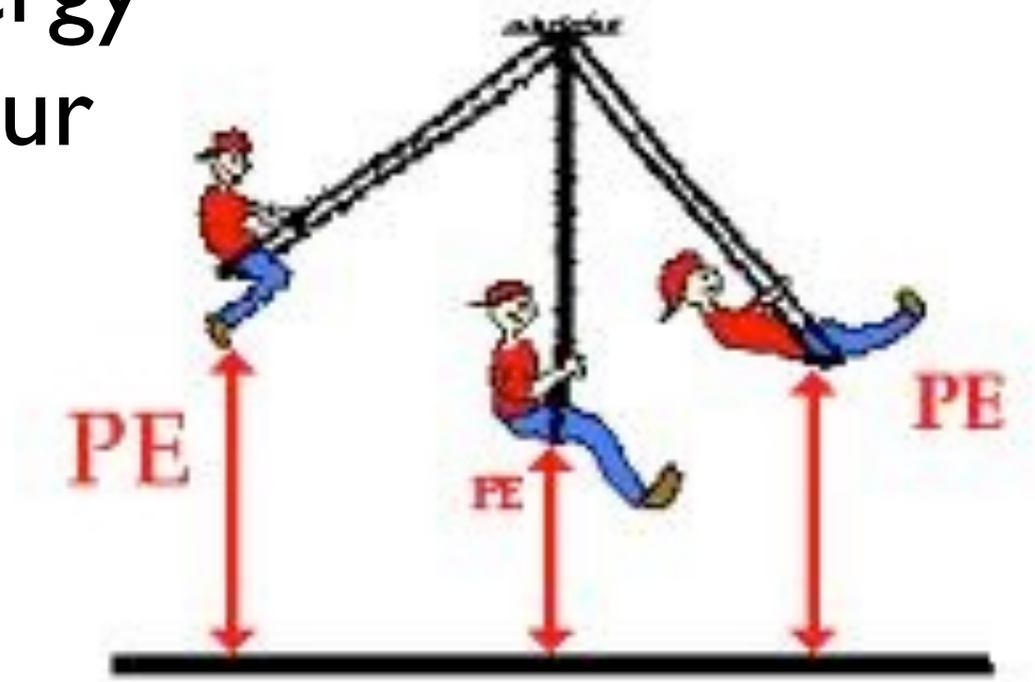
How does the potential energy change when you double your height?

A. Doubles

B. Quadruples

C. Cuts in half

D. Cuts in one fourth



$$PE = mgh$$

How does the kinetic energy change when you double your velocity?

A. Doubles

B. Quadruples

C. Cuts in half

D. Cuts in one fourth

$KE = 1/2mv^2$